The Trend to Smaller Producers in Manufacturing In Canada and the U.S.

By

John R. Baldwin
Micro-Economics Analysis Division
Statistics Canada
Voice: 951-8588
Fax: 951-5403
Email: baldjoh@statcan.ca

Ron S. Jarmin
Center for Economic Studies
U.S. Bureau of the Census
Voice: (301) 457-1858
Fax: (301) 457-1235
Email: rjarmin@ces.census.gov

Jianmin Tang
Micro-Economic Policy Analysis
Industry Canada
Voice: (613) 941-1621
Fax: (613) 991-1261
Email: tang.jianmin@ic.gc.ca

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Abstract

This paper examines the trend in the importance of small producers in the Canadian and U.S. manufacturing sectors from the early 1970s to the late 1990s in order to investigate whether there was a common North American trend in changes in plant size. It finds that small plants in both countries increased their share of employment up to the 1990s, but their share remained stable in the 1990s. Small plants increased their share of output up to the 1990s, but then saw their share of output decline. Over the entire time period, their share of output increased less than their share of employment and, therefore, their relative labour productivity has fallen. The similarity in the trends in the two countries suggests that causes of this phenomenon should be sought in similarities such as the technological environment rather than in country-specific factors like unionization or trade intensities.

Keywords: small business, plant size distribution, productivity, employment growth, disintermediation

Executive Summary

The growing importance of small plants is seen as a sign that there has been a radical shift in the ability of small producers to compete with large producers that is leading to the decline of large businesses and the growth of smaller businesses. This paper looks at the evidence for the Canadian and U.S. manufacturing sectors over the last quarter of a century to discern trends in the importance of small producers. It focuses on whether the trends that were observed earlier in the 1970s and 1980s have continued into the 1990s. It also asks whether the events in Canada were different than those of the United States.

The paper focuses on five key questions. They are:

1) What has been the trend in the share of employment accounted by small plants in the Canadian and U.S. manufacturing sectors?

During the 1970s and 1980s, small Canadian and U.S plants both increased their share of employment. But the 1990s have put an end to this trend. The employment share of smaller plants has been relatively stable in the 1990s.

2) Have small Canadian and U.S. plants increased their share of output as much as they increased their share of employment?

During the 1970s and 1980s, small Canadian and U.S. plants both increased their share of output. But during the 1990s, their share has begun to fall. Together the evidence on both employment and output suggests that the era of increasing importance of small producers, at least in manufacturing, has come to an end.

3) What has happened to the relative labour productivity of small Canadian and U.S. plants?

The relative labour productivity of small Canadian and U.S plants fell during the 1970s and 1980s as their share of output increased at a slower rate than did their employment share. In the 1990s, their relative labour productivity continued to fall. Small plants continue to fall behind large plants either because they are less capital intensive or because they are less efficient.

4) Is there a difference between the importance of small plants in Canada and the United States?

Canada has a larger proportion of employment in small plants than does the United States. But the trend over the last quarter century has been similar in the two countries.

5) Has there been a similar trend in the falling productivity of smaller plants in the two countries?

Both countries have experienced a decline in the relative productivity of small plants relative to large plants. The similarities in this area suggest that it is commonalities in the technological environment that are driving the changing relative productivity of small and large plants rather than country-specific factors such as unionization or trade intensities.

Introduction

In this paper, we compare differences in the size distributions of Canadian and U.S. manufacturing plants and changes in these distributions occurring over the last thirty years. Numerous studies have demonstrated the growing share of employment at small manufacturing establishments during the 1970s and 1980s. We update these studies with data from the 1990s for both Canada and the U.S.

Small manufacturing plants differ from their larger counterparts in a number of ways. They typically are less productive, less capital intensive, pay lower wages and are more likely to fail. Thus, tracking changes in the size distribution of manufacturing plants is important for understanding trends in productivity and incomes. In addition, there has been a spirited debate on the importance of small manufacturers in generating job growth and innovation.

Various causes have been suggested for the increase in the importance of small producers that has occurred in both Canada and the U.S. First, increases in small producers may reflect the increased need for the type of flexibility that small firms offer. It may be that changes in advanced manufacturing technology have increased the flexibility of small producers and, therefore, the relative advantage that small producers have always possessed. Or these technological changes may have reduced the advantages of scale possessed by large plants. Or it may be that consumer demand has shifted to require more of the goods and services that small plants have a comparative advantage in producing.

Second, the increased importance of small plants may be the result of increased outsourcing by large producers. New advanced technologies may not so much have affected the type of scale economies in assembly that large producers enjoy as it has affected the advantage or disadvantage of organizing all the production stages within the firm. Advanced communications technologies may have made it easier to outsource functions that were once conducted within the firm via arm's-length transactions.

Third, small firms may have expanded in response to changes in the relative prices of factors such as labor and capital. If capital markets improved over the post-war period, and the cost of capital for small firms has been reduced relative to large firms, then small-firm growth may just be a response to this change. Alternately, the growth in small firms may have been the result of imperfections in unionized labor markets in large firms. Faced with downward wage pressure from increasing globalization, labor markets in small firms may have offered more flexibility and small firms may have grown in response to labor market rigidities experienced by large plants.

One way to assess the strength of these various theories is to compare the changes that have occurred in Canada to the changes that have occurred in the United States. Changes in the structure of the Canadian manufacturing sector may have been caused by general factors that are common to North American industry or to factors that are specific to Canada. Finding similarities between Canada and the United States would suggest that we search for general causes rather than Canada-specific causes.

A comparison of changes in the size distribution in Canada and the United States also permits us to investigate a potential cause in the widening of the Canada/U.S productivity gap. The level of labor productivity in Canadian manufacturing compared to that of the United States is of constant interest to Canadian policy makers. Growth in small, less productive producers in Canada does not at first glance reduce the difference between the two countries and may very well have reduced Canadian productivity relative to the United States. But differences in the productivity performance of Canada and the United States depend not only on events in Canada; they also depend upon whether the firm-size structure in the United States is changing in similar or different ways. Therefore, an evaluation of the effect of changes in the size distribution of employment in Canada requires a cross-country comparison of the changes in Canada to the changes that were taking place at the same time in the United States.

Background

Debates on industrial policy have focused during much of the post-war period on the necessity of providing special support for the small-firm sector. Many policy interventions during this period have focused on the adequacy of financing, and access to technology for small manufacturers (SBA 2000).

During the 1970s and 1980s, concerns for the interests of the small-firm sector were attenuated by research results that appeared to show that the small-firm sector, far from being moribund, was actually one of the most dynamic of the economy-at least when it came to employment growth.

Interest in the importance of small firms has been driven by studies that show the proportion of employment in small firms or small plants has been increasing in many European and North American countries (OECD, 1985). This change, it was pointed out, came not so much from the fact that large firms were decreasing their work force-as the fact that net job growth was much faster in small firms than in large firms (Birch, 1987; Armington and Odle, 1982).

In these studies, job growth was measured as the sum of job increases due to the creation of new firms and the expansion of existing ones. Job contraction was measured as the destruction of jobs in firms that exited industries and the reduction in jobs in firms that were contracting. Net change in job growth for a particular size class is just the difference between job growth and job contraction for all firms in a particular size class.

Job growth was found to be larger in smaller firms as a whole because small firms were being created at a faster pace than were large firms and the employment in small firms was expanding faster than that that of large firms. Kirchoff and Phillips (1988) note that in the case of the United States, the majority of job creation came from entry rather than small-firm growth. Similar results have been reported for Canada (Baldwin and Gorecki, 1990; Baldwin and Gorecki, 1994).

The findings of these studies were, at first, greeted with criticism. At first, the criticism focused on the accuracy of the data that was used for measurement of job change (MacDonald, 1985; Storey and Johnson, 1986; Reynolds et al., 1985). But others criticized the job-change studies for failing to take into consideration the Galtonian regression-to-the-mean effect when estimating the rate of net job change by size class (Davis, Haltiwanger and Schuh, 1993). Job growth tends to follow a random walk with negative serial correlation. Fast growth in one period is followed by slower growth in the next period. In a world where growth consists of a random variation of firm size around a long-run value, failing to take this into account when rates of job change are compared across different size classes could lead to the mistaken impression that small firms are growing and large firms are declining.

The theme that small firms are especially innovative (Rothwell and Zegveld, 1982; Acs and Audretsch, 1990) has reinforced the interest that has been expressed in small-firm growth. But Brown, Hamilton and Medoff (1990) point out that not all small firms are innovative and that many small firms tend to have jobs that are much more unstable, with higher turnover rates and pay lower wages than large firms.

Baldwin (1998) reports that average wages of all production workers in manufacturing plants are lower in smaller plants. More importantly, the average wage paid in small plants had fallen more or less continuously relative to larger plants during the 1970s and 1980s. When jobs are standardized for wage-rate differences between small and large plants, job growth in small plants was found to be similar to that in large plants.

Smaller firms and establishments are also less likely to use advanced technologies (Baldwin and Sabourin, 1995; Dunne 1994; Kelly and Brooks 1991) and have higher exit rates than their larger counterparts (Dunne, Roberts and Samuelson 1989; Baldwin et al., 1999; Jarmin, 1998). Indeed, there has been considerable public effort to improve access to technology at small and medium sized manufacturers.[1]

The important conclusion to be drawn from these studies was that while small firms may have increased their share of employment, they could not unambiguously be regarded as the dynamos of growth. The emergence of new, less productive manufacturing firms accounting for a larger percentage of employment would have slowed growth in productivity. Of course, the latter might simply be the result of outsourcing-of larger firms spinning off their less productive activities to outside sources. But if this is the explanation for the falling relative productivity of smaller firms, the growth of this sector does not presage the dramatic emergence of a new small-firm sector that will compete with larger firms-rather it simply indicates a restructuring of existing firms.

[1] SBA (2000) and Feller (1997) provide overviews of several such programs in the U.S. and discuss their rationale. Jarmin (1999) examines the effectiveness of one program on improving the productivity performance of small and medium sized plants.

Data

For our comparisons, we make use of the plant-level data for the manufacturing sector that come from the surveys done by both Statistics Canada and the U.S. Census Bureau. Both countries perform very similar surveys of plants in the manufacturing sector, collecting data on plants' manufacturing activities with respect to shipments, employment, materials usage, and value added. Both countries conduct these surveys at the level of the establishment or plant. Both use quite similar definitions for most variables—in particular, both distinguish between production and non-production workers, and define total employment as the sum of the two. Both measure value added as total shipments plus changes in inventories minus expenditures on materials. Both perform essentially a census of all establishments by using both surveys and administrative data to cover the universe of plants in the manufacturing sector.

One important difference is that Canada provides comprehensive annual data but the United States only conducts a census every five years. For intervening periods, the U.S. generates annual survey data that are neither comprehensive (the Census Bureau omits all plants with less than five employees and samples those with less than 250) nor equally accurate. As the U.S. annual survey moves further away from the census year, the frame used for the annual survey misses an increasing number of new births (Davis, Haltiwanger and Schuh, 1991). It is for this reason that we choose to compare Canada and the United States only for the years in which the U.S. conducts its quinquennnial census—1972[2], 1977, 1982, 1987, 1992, and 1997.[3]

There are also minor differences in the way that both countries treat auxiliary establishments (e.g., head offices, warehouses, R&D labs and so on). Canada includes these in its manufacturing survey but the United States does not. In this study, we include Canadian auxiliaries in all calculations. We have experimented with removing them from the Canadian results and found that it has little effect on the results that we report. For example, removing auxiliaries increases Canadian value added per worker by about 2%.

In order to conduct the comparison, we make use of a longitudinal file with all Canadian plants classified on the basis of the Canadian1980 SIC.[4] The U.S. data use two different U.S. SIC codes—the 1972 SIC code up to 1987 and the 1987 code from 1987 onward.

In what follows, we compare shipments, employment and value-added in small, medium and large plants in both Canada and the United States. Small plants are those with 0 to 100 employees, medium-sized plants are those with 101-500 employees, and large plants are those with over 500 employees.

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[2] For 1972, we had to make use of 1973 data because we did not have Canadian data in 1972 classified on a 1980 SIC code.

[3] We also include U.S. data for 1994 from its Annual Census since this is the year that the annual survey expands its frame to take into account the 1992 expanded population.

[4] This was done by using commodity data on a plant's production to reclassify all plants prior to 1982 on the basis of the 1970 SIC code.

In the case of the United States, we make use of the concepts of total employment, value of shipments and census value-added estimates as are published in the U.S. Census Bureau's quinquennial censuses on manufacturing. The concepts are defined in U.S. Department of Commerce (1993). We derive the data used for the different plant-size groups and the corresponding totals from micro-economic data files maintained by the Center for Economic Studies, U.S. Bureau of the Census.

For Canada, we make use of the concept of total employment, shipments and census value-added. These differ from what are termed manufacturing shipments and manufacturing value added because they contain, among other items, resales of goods purchased and resold without further processing. These are derived from the Census micro-economic records. Total employment is defined as the sum of production and non-production workers.

Output and Employment Shares

The employment and output shares of small, medium, and large plants in the United States and Canada over five year periods from 1972 to 1997 are compared in Table 1.

Canada generally has a larger share (ranging from 4 to 8 percentage points) of employment in small plants. Canada also has a larger share (ranging from 2 to 6 percentage points) in the medium-sized class. In contrast, Canada has a lower share (ranging from 9 to 11 percentage points) in the largest size classes.

Of greater interest is the similarity in the trends in each category. The increase in the importance of the smallest size class and the decline in the largest size class for Canada are mirrored in the United States (Figure 1). Between 1972 and 1997, small plants gained 8.7 percentage points of employment share in Canada and 5.8 percentage points in the United States, for rates of change of 30% and 23%, respectively. Between 1972 and 1997, large plants lost 9.1 percentage points in Canada and 8.7 percentage points in the United States, for rates of change of 28% and 21%, respectively.

INSERT TABLE 1 HERE

Moreover, both countries show the same evidence of a discontinuation of the employment shift from large to small plants during the 1990s—though the change is somewhat more abrupt in the United States.

Both countries also exhibit similar trends in terms of share of output by size class. While the share of employment in small plants increases in both countries prior to 1990, the share of output does not keep pace with the change in the share of employment. In Canada, the share of shipments in small plants is virtually the same in 1997 as in 1972. This is also the case for the United States. For value added, the share of small plants in Canada increases slightly (by less than 2 percentage points between 1972 and 1997), while that in the United States increases by less than 0.2 percentage points.

In large plants, there are similar declines in the share of shipments—about 2 percentage points –in both countries. The decline in the share of value added is somewhat larger in Canada than in the United States (5 and 1 percentage points, respectively).

Relative Labor Productivity

The share of output of a size class when divided by the share of employment of the same size class provides a measure of labor productivity of that size class relative to overall labor productivity.[5] Measures of relative value added per worker and relative shipments per worker for small, medium and large plants are provided in Table 2 for each of Canada and the United States.

INSERT TABLE 2 HERE

Whether we use value added or shipments to measure output per worker, the results are similar. Small plants in both the United States and Canada have seen their labor productivity decline and the decline is quite similar in both countries. Small-plant value-added productivity declines from 84% of the average in the United States in 1972 to 69% of the average in 1997—a decline of 15 percentage points. In Canada, the decline is 11 percentage points over the same period. If shipments per worker are used, the decline is 18 and 19 percentage points in the United States and Canada, respectively. What is equally significant is that the decline continues in both countries into the 1990s.

If instead we compare the relative productivity of large plants in Canada and the United States, the results are also quite similar. Relative value added per worker of large plants increases by 26 and 22 percentage points in the United States and Canada, respectively. There is more of a difference if shipments are used as a measure of output. Relative shipments per worker of large plants increases by 23 and 31 percentage points in the United States and Canada, respectively.

INSERT TABLE 3 HERE

Both countries then have seen a decrease in the productivity of small plants and an increase in the productivity of large plants relative to the average of all plants. The ratio of the labor productivity of small to large plants is provided in Table 3. These ratios for value added per worker and shipments per worker are depicted in Figures 2 and 3, respectively.[6] In the U.S, small plants actually have a slightly greater decline in value added per worker relative to large plants than in Canada. In the United States, the decline is some 26-percentage points while in Canada it is 21 percentage points.

It should be noted that the differences between Canada and the United States are even less if labour productivity is measured with shipments per worker. The decline in

[5] This provides a weighted average of labour productivity.
[6] Once again, this uses weighted averages.

shipments per worker of small divided by large plants is about 26 percentage points in both countries (Figure 3).

Canada shows remarkable similarities to the United States with regards to the structural changes that have occurred in the size distribution of plants in the manufacturing sector during the last twenty years. In both countries, small plants gained employment share up to the end of the 1980s. In both countries, this trend ended in the 1990s.

Equally important, the increase in small-plant employment share in both countries was not accompanied by the same increase in output share. As a result, small plants have seen their labour productivity fall relative to large plants. Moreover, this trend has continued into the 1990s.

In summary, the similarity in the structural change in the two countries means that it is unlikely that the causes of the change can be found in country-specific circumstances. That the same changes in size distribution are found in both countries suggests that the causes of restructuring must be found elsewhere—either in changes in technology or in changes that have led to more outsourcing or disintermediation.

Disintermediation

Outsourcing or disintermediation is one possible reason for both the increases in employment found in small plants and for their decreasing relative labor productivity. If large highly capital-intensive plants outsourced their less capital-intensive activities, the result would be a growing small-plant segment that was less productive than large plants.

If disintermediation is the explanation for the growth of small plants over the 1970s and 1980s, we might expect to find that a measure of vertical integration of the plant—the ratio of value of shipments to value added—would have changed over time, step for step, with changes in the importance of small plants. Plants that replace their internal operations by making external purchases of services or goods would expect no change in their shipments to customers, but their value added would decrease relative to their shipments—or shipments should increase relative to value added. If a firm splits into two, the total shipments reported by the two entities would be larger than for the previous single entity, but the amount of value added created in the two entities would be the same as in the single entity. Once more, shipments to value-added ratios would rise for the combined entities. In the manufacturing sector as a whole, disintermediation would increase the amount of inter-firm transactions relative to the amount of real GDP that is created.

In order to investigate this possibility, we present the ratio of shipments to census value added[7] in Canadian and U.S manufacturing as a whole and in each size class in Table 4. Overall, the ratio of shipments to GDP in both countries shows an increase up to the SIC revision in 1982, but then it trends slowly downward (Figure 4). Vertical

[7] As previously noted, census value added is larger than the value added that sums to GDP because it contains purchased services.

disintermediation should have been accompanied by a general increase in the ratio. At the most, this phenomenon functioned prior to the 1982 SIC revision. Since the value of shipments to value added does not increase continuously over the period but the share of employment in small plants increases until 1990, it is difficult to ascribe changes in the importance of small plants over the period from the early 1970s to 1990 to continuous disintermediation.

There is, however, a distinct upward trend in the ratio of shipments to value added in larger plants in the Canadian manufacturing sector. This is the case for both small and medium-sized plants up to 1982. However, after 1982, the upward trend continues for larger plants while the ratio of shipments to value added in smaller and medium-sized plants declines between 1982 and 1987 and then is relatively constant thereafter.

A different way of examining the size-class differences is to compare the share of shipments to the share of value added produced by a size class. These ratios are presented, by size class, for the United States and Canada, in the second panel of Table 4. If each size class has about the same tendency to use outside sources of services and materials, then the share of shipments and value added should be about the same. This is the case for the United States, where the ratio is about 1 for each size class and does not change much over time. In Canada, the ratios are about 1 for each size class at the beginning of the period but they decrease in the smallest size class and they increase in the largest size class. This indicates a substantial change in the largest size class in Canada relative to the same size class in the United States.

In summary, it is difficult to ascribe the structural change that has seen small plants increase their share of employment to disintermediation on the basis of the evidence presented here. First, changes in a measure of disintermediation (sales/value added ratios) over time do not correspond closely with increases in the share of employment found in small producers. The former increases in the 1970s, decreases in the 1980s, while the latter steadily increases. Second, while the change in the importance of small producers is similar in both Canada and the United States, the history of disintermediation is not the same—particularly in large producers. Canadian large producers have seen a much greater increase in their sales/value-added ratios than large U.S. producers, yet both countries have experienced the changes in the relative importance and productivity of different size classes.

Discussion and Conclusion

In this paper, we have reviewed and compared the performance of small manufacturers in Canada and the United States. The changes across the size distribution of manufacturing plants in Canada mirrored those occurring in the United States over the same time period, both with respect to the percentage-point gain in the employment share of small plants and also in terms of the percentage point declines of the relative productivity of small relative to large plants.

Between the early 1970s and 1990, the share of employment in small plants increased in both countries but this process peaked in the 1990s. At the same time, the relative labour productivity of small plants declined over the entire period.

This is the second paper to compare the structure of the two economies using matched data from the censuses of manufactures for Canada and the United States. Earlier research by Baldwin, Dunne and Haltiwanger (1998)[8] found that the characteristics of job turnover in the two economies were quite similar in many dimensions. Despite differences in the degree of unionization, market concentration, and international trade intensity, the rates of job creation, job destruction, total job reallocation, job creation due to entry, and job destruction due to exit exhibit a number of striking similarities. First, the aggregate levels of turnover for the entire manufacturing sector and for 2-digit industries measured over annual and five-year periods were equal in magnitude. Second, correlations in these rates of changes across industries were very high, thereby indicating that patterns of inter-industry differences were quite similar. While there were slight differences in the year-to-year movements due to differences in macro-economic fluctuations, when allowance was made for these differences, the turnover rates become even more similar.

We have previously noted how remarkable these similarities are in light of the many differences in the manufacturing sectors of the two economies. Although the two countries occupy the same continent, there are significant differences in their social and economic systems. The Canadian economy is subject to more foreign competition—the export and import intensities are higher. A larger percentage of the Canadian manufacturing sector is foreign-controlled; there are higher levels of unionization in Canada, and Canadian markets are more concentrated than U.S. markets.

Plant turnover as measured by entry and exit rates, as well as job growth and job contraction, captures the amount of underlying dynamic change in an economy as some plants grow and others decline. Since Canadian plant turnover is similar to that of the United States, the explanation for similar turnover rates is to be found in common, not different, factors. This is strongly suggestive that the principal determinants of turnover are to be found in the technology base of an industry, since the two countries' manufacturing sectors are different in so many other dimensions. The major commonality is the production technologies that determine the degree of turnover in an industry.

This paper has shown that there are also similarities in the dynamics of change in the importance of small and large size classes. These changes also can be attributed to both technological and non-technological factors.

The increasing importance of small firms has intrigued analysts for several reasons. First, it has suggested to some that a radical change in the firm-size distribution may be about to occur—possibly because of a reduction in the importance of those factors like scale and scope economies. The traditional scale-related advantages of size, it is sometimes suggested, may have been reduced by the introduction of new advanced computer-driven

[8] See also chapter 6 in Baldwin (1995)

technologies that have given small producers the ability to produce shorter production runs at less of a competitive disadvantage.

This explanation for the growing importance of small producers is not compatible with evidence on the differences across plant size classes in the adoption rates of new advanced manufacturing technologies. Evidence, from surveys on the use of these new technologies, shows that larger producers are more likely to adopt these technologies than smaller firms (Baldwin and Sabourin, 1995). Moreover, the difference between small and large producers in either country does not seem to have narrowed during the 1990s.

Others have pointed out that the increasing importance of small producers might simply have arisen from a disintermediation of the production process and that large firms could simply have been outsourcing a number of functions that they once found it advantageous to perform internally. These changes may have come from new computer-based technologies that permit improved co-ordination of arm's-length transactions.

Earlier results provided some evidence that was compatible with this explanation. Baldwin (1996, 1998) pointed out that the choice of metric influenced the conclusion that small firms were increasing in importance. In particular, while small producers might well have been increasing their share of employment, there was less evidence that their share of output had increased. And, as a result, the labour productivity of small producers relative to large producers decreased at the same time as their employment share increased. This could well have been the result of a disintermediation process that caused large producers to divest themselves of their least productive operations. However, the evidence presented here is not supportive of this explanation.

Still other explanations are available for the shift of employment to smaller producers that are more country specific. First, rigid labour markets in the large producer sector might well have led small producers to expand at the expense of large producers. Canada has a higher degree of unionization and therefore the growth of small producers may simply have been a response to labour market imperfections in its large producers.

Second, trade liberalization may be responsible for restructuring. If large multinationals, which control a major portion of Canada's manufacturing sector, have chosen to leave the country after the major trade liberalization of the late 1980s, then small producers would have become more important.

The results of this paper suggest that country-specific explanations are not a sufficient explanation of the growth that has occurred in the small-firm sector. The similarities in the changes in the plant-size distribution suggest that similarities between Canada and the United States, rather than differences, account for this change. Technology is quite similar in the two countries. It is this similar technological base to which we have previously attributed similarities in the patterns of dynamic change associated with entry, exit, job growth and job decline.

Changes in the size-class structure result from the dynamic process that sees some producers exit or contract and others grow and enter markets. Perhaps more importantly, the changes in the size-class structure can be interpreted not just to involve the dynamic replacement of some producers with others, though that is part of the process (Baldwin, 1996); they also involve changes in the underlying technology. Differences in labour productivity are closely related to differences in technology usage. Plants using advanced technologies are more productive (Baldwin, Diverty and Sabourin, 1995; Baldwin and Sabourin, 2001). Plants using advanced technologies pay higher average wages (Baldwin, Gray and Johnson, 1995; Baldwin and Rafiquzzaman, 1999). The fall in small producer labour productivity that has accompanied the transformation in industrial structure is probably closely related to differences in technology use between small and large plants.

In summary, while there are significant differences in the size structure of the two manufacturing sectors (the U.S. has a higher share of employment in larger plants), changes that have been occurring in the two countries are strikingly similar—at least at the level of the manufacturing sector as a whole.

References

Acs, Z.S. and D. B. Audretsch. 1990. *Innovation and Small Firms*. Cambridge, Mass.: MIT Press.

Armington, Catherine and Marjorie Odle, 1982. "Small Business: How Many Jobs?" *The Brookings Review* 1 (Winter): 7-14.

Baldwin, John R. 1995. *The Dynamics of Industrial Competition: A North American Perspective*. Cambridge: Cambridge University Press.

Baldwin, John R. 1996. "Productivity Growth, Plant Turnover and Restructuring in the Canadian Manufacturing Sector." In *Sources of Productivity Growth,*" Edited by David Mayes. Cambridge: Cambridge University Press. pp. ??.

Baldwin, John R. 1998. "Were Small Producers the Engines of Growth in the Canadian Manufacturing Sector in the 1980s." *Small Business Economics* 10: 349-64.

Baldwin, John, Brent Diverty, and David Sabourin. 1995. In T. Courchene (ed.) *Technology, Information, and Public Policy*. John Deutsch Institute for the Study of Economic Policy. Kingston, Ontario: Queens University.

Baldwin, John, Tim Dunne and John Haltiwanger. 1998. "A Comparison of Job Creation and Job Destruction in Canada and the United States." *Review of Economics and Statistics*. 80: 347-57.

Baldwin, John, G. Gellatly, L. Bian and R. Dupuis. 1999. *Failure Rates for New Canadian Firms: New Perspectives on Entry and Exit*. Catalogue No. 61-526-XPE.

Baldwin, John, Tara Gray, and Joanne Johnson. 1995. "Advanced Technology Use and Training in Canadian Manufacturing," *Canadian Business Economics*.5: fall, 1996. 51-70.

Baldwin, John R. and Paul K Gorecki. 1990. *Structural Change and the Adjustment Process*. Ottawa: The Economic Council of Canada.

Baldwin, John R. and Paul K. Gorecki. 1994. "Dimensions of Labour-Market Change in Canada: Intersectoral Shifts, Job and Worker Turnover." *Journal of Income Distribution.* 3: 148-180.

Baldwin, John and Mohammed Rafiquzzaman. 1999. "Trade, Technology and Wage Differentials in the Canadian Manufacturing Sector," in *Innovation, Industry Evolution and Employment*. Edited by D.B. Audretsch and R.A. Thurik. Cambridge University Press. pp. 57-85.

Baldwin, John and David Sabourin. 1995. *Technology Adoption in Canadian Manufacturing*. Catalogue 88-512-XPB. Ottawa: Statistics Canada.

Baldwin, John and David Sabourin. 2001. *Impact of the Adoption of Advanced Information and Communications Technologies on Firm Performance in the Canadian Manufacturing Sector*. Research Paper No. 174. Analytical Studies Branch. Ottawa: Statistics Canada.

Birch, David. 1987. *Job Creation in America.* New York: The Free Press.

Brown, C., J. Hamilton, and J. Medoff. 1990. *Employers Large and Small*. Cambridge, Mass: Harvard University Press.

Davis, S.J., J. Haltiwanger, and S. Schuh. 1991. "Published versus Sample Statistics from the ASM: Implications for the LRD". Working Paper #91-1. U.S. Center for Economic Studies. U.S. Bureau of the Census. Washington.

Davis, S.J., J. Haltiwanger, and S. Schuh. 1993. Small Business and Job Creation: Dissecting the Myth and Reassessing the Facts. Working Paper No. 4492. National Bureau of Economic Research.

Dunne, T., (1994), Plant Age and Technology Use in U.S. Manufacturing Industries, *RAND Journal of Economics*, 25(3), pp. 488-499.

Dunne, T., M.J. Roberts and L. Samuelson, (1989), "The Growth and Failure of U.S. Manufacturing Plants," *Quarterly Journal of Economics*, Vol. 104, pp.495-515.

Feller, I., (1997), "Manufacturing Technology Centers as Components of Regional Technology Infrastructures," *Regional Science & Urban Economics*, 27, pp. 181-197.

Jarmin, R.S. 1998, "Manufacturing Extension and Plant Survival", *Proceedings of the APEC Symposium on the Evaluation of S&T Programmes among APEC Member Economies*, APEC # 98-IT-04.2, National Center for Science and Technology Evaluation, Ministry of Science and Technology of China, Beijing.

Jarmin, R.S., 1999, "Evaluating the Impact of Manufacturing Extension on Productivity Growth," *Journal of Policy Analysis and Management* Vol. 18, No. 1, pp. 871-891.

Kelly, M.R. and H. Brooks, (1991), "External Learning Opportunities and the Diffusion of Process Innovations to Small Firms," *Technological Forecasting and Social Change*, 39, pp. 103-125.

Kirchoff, B. A. and B. D. Phillips. 1988. "The Effect of Firm Formation and Growth on Job Creation in the United States," *Journal of Business Venturing* 3: 261.

MacDonald, James M. 1985. "Dun and Bradstreet business microdata research applications, and the detection and correction of errors." *Journal of Economic and Social Measurement* 13: 173-85.

Organization for Economic Cooperation and Development. 1985. "Employment in Small and Large Firms: Where Have the Jobs Come From?" *Employment Outlook* Paris: OECD pp. 64-82.

Reynolds, Paul D., Stephen West, and Michael D. Finch. 1985. "Estimating new firms and new jobs: Consideration in using the Dun and Bradstreet Files," in *Frontiers of Entrepreneurship Research.* Edited by John A. Hornaday, Edward Shils, Jeffrey A. Timmons. And Karl H. Vesper. Wellesley Mass: Babson College.

Rothwell, R and W. Zegveld. 1982. *Innovation in the Small and Medium-Sized Firm*. London: Francis Pinter.

Storey, David and Steven Johnson. 1986. "Job Generation in Britain: A review of recent studies." *International Small Business Journal* 4: 29-46.

U.S. Department of Commerce. 1993. 1987 Economic Censuses Cd-rom Report Series. Release 1E. Part 2.

U.S. Small Business Administration, 2000, *Building the Foundation for a New Century: Final Report on Implementation of the 1995 White House Conference on Small Business*, U.S. Government Printing Office, Washington, DC.

Table 1
Comparison of employment and output shares for manufacturing plants: Canada and the United States

	United States				Canada		
	% of total employment				% of total employment		
Year	Small	Med	Large		Small	Med	Large
1972*	24.8	33.4	41.8		28.6	39.4	32.0
1977	25.4	33.6	41.0		30.4	38.1	31.6
1982	28.4	33.7	37.8		34.2	37.1	28.7
1987	29.5	34.5	36.0		35.1	38.7	26.2
1992	30.6	35.7	33.7		38.1	37.6	24.2
1994	28.7	36.7	34.6		37.3	39.3	23.4
1997	30.6	36.4	33.1		37.3	39.8	22.9
	% of total shipments				% of total shipments		
Year	Small	Med	Large		Small	Med	Large
1972*	21.1	31.5	47.4		23.1	37.2	39.7
1977	20.4	31.2	48.4		22.0	37.0	41.0
1982	21.3	32.5	46.2		25.0	39.4	35.6
1987	21.7	32.9	45.4		24.4	38.4	37.2
1992	21.3	33.8	44.9		24.4	39.4	36.2
1994	19.9	34.3	45.7		22.5	37.8	39.7
1997	20.5	34.4	45.1		23.0	39.3	37.7
	% of total value added				% of total value added		
Year	Small	Med	Large		Small	Med	Large
1972*	20.9	30.5	46.4		23.4	37.6	39.0
1977	20.5	30.4	49.1		23.7	38.0	38.3
1982	22.1	31.5	46.5		27.5	38.3	34.2
1987	22.0	32.1	45.9		25.8	39.0	35.2
1992	21.9	33.0	45.1		27.3	41.0	31.8
1994	20.4	33.8	45.8		25.3	41.8	32.9
1997	21.1	33.7	45.3		25.1	41.3	33.6
*1972 for the U.S. and 1973 for Canada							

Table 2
Comparison of labour productivity for each plant size class relative to the industry average: Canada and the United States

	United States				Canada		
	Relative value added per employee				Relative value added per employee		
Year	Small	Med	Large		Small	Med	Large
1972*	0.84	0.91	1.11		0.82	0.95	1.22
1977	0.81	0.91	1.20		0.78	1.00	1.21
1982	0.78	0.93	1.23		0.81	1.03	1.19
1987	0.75	0.93	1.27		0.73	1.01	1.35
1992	0.72	0.92	1.34		0.72	1.09	1.31
1994	0.71	0.92	1.32		0.68	1.06	1.41
1997	0.69	0.93	1.37		0.67	1.04	1.47
	Relative shipments per employee				Relative shipments per employee		
Year	Small	Med	Large		Small	Med	Large
1972*	0.85	0.95	1.13		0.81	0.94	1.24
1977	0.80	0.93	1.18		0.72	0.97	1.30
1982	0.75	0.96	1.22		0.73	1.06	1.24
1987	0.74	0.95	1.26		0.69	0.99	1.42
1992	0.70	0.95	1.33		0.64	1.05	1.49
1994	0.69	0.94	1.32		0.60	0.96	1.70
1997	0.67	0.95	1.36		0.62	0.99	1.65
*1972 for the U.S. and 1973 for Canada							

Table 3
Comparison of relative productivity of small relative to large plants: Canada and the United States

	United States				Canada		
	Relative Productivity (value added)				Relative Productivity (value added)		
Year	Small/Large	Med/ Large	Small/ Med		Small/ Large	Med/ Large	Small/ Med
1972*	0.76	0.82	0.92		0.67	0.78	0.86
1977	0.68	0.76	0.89		0.64	0.82	0.78
1982	0.63	0.76	0.83		0.68	0.87	0.78
1987	0.59	0.73	0.80		0.55	0.75	0.73
1992	0.54	0.69	0.77		0.55	0.83	0.66
1994	0.54	0.70	0.77		0.48	0.76	0.65
1997	0.50	0.68	0.74		0.46	0.71	0.65
	Relative Productivity (shipments)				Relative Productivity (shipments)		
Year	Small/Large	Med/ Large	Small/ Med		Small/Large	Med/ Large	Small/ Med
1972*	0.75	0.83	0.90		0.65	0.76	0.86
1977	0.68	0.79	0.86		0.56	0.75	0.75
1982	0.61	0.79	0.78		0.59	0.86	0.69
1987	0.58	0.76	0.77		0.49	0.70	0.70
1992	0.52	0.71	0.73		0.43	0.70	0.61
1994	0.52	0.71	0.74		0.35	0.57	0.62
1997	0.49	0.69	0.71		0.37	0.60	0.62

*1972 for the U.S. and 1973 for Canada

Table 4
Comparison of shipments to value added by plant size class: Canada and the United States

	United States					Canada			
	Shipments divided by value added					Shipments divided by value added			
Year	All	Small	Med	Large		All	Small	Med	Large
1972*	2.14	2.16	2.21	2.18		2.45	2.48	2.43	2.46
1977	2.32	2.31	2.38	2.29		2.60	2.50	2.59	2.64
1982	2.38	2.30	2.45	2.37		2.86	2.62	2.97	2.93
1987	2.12	2.09	2.18	2.10		2.57	2.48	2.54	2.67
1992	2.11	2.05	2.16	2.10		2.61	2.38	2.54	2.90
1994	2.09	2.04	2.12	2.08		2.61	2.39	2.39	3.07
1997	2.06	2.01	2.10	2.05		2.57	2.43	2.52	2.73

	United States				Canada		
	Share of shipments divided by share of value added				Share of shipments divided by share of value added		
Year	Small	Med	Large		Small	Med	Large
1972*	1.01	1.03	1.02		0.99	0.99	1.02
1977	1.00	1.03	0.99		0.93	0.97	1.07
1982	0.96	1.03	0.99		0.91	1.03	1.04
1987	0.99	1.02	0.99		0.95	0.98	1.06
1992	0.97	1.02	1.00		0.89	0.96	1.14
1994	0.98	1.01	1.00		0.89	0.90	1.21
1997	0.97	1.02	1.00		0.92	0.95	1.12

*1972 for the U.S. and 1973 for Canada

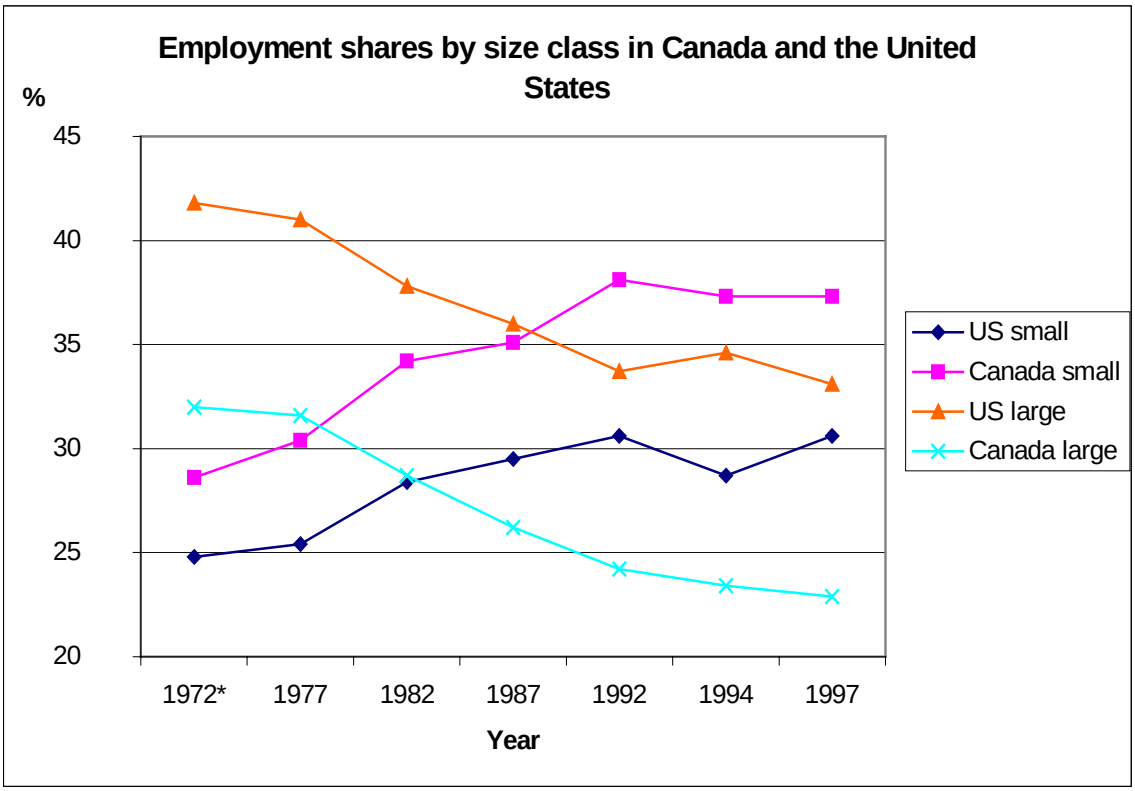
Employment shares by size class in Canada and the United States
%
45
40
35
30
25
20
1972*
1977
1982
1987
1992
1994
1997
Year
US small
Canada small
US large
Canada large

Figure 1

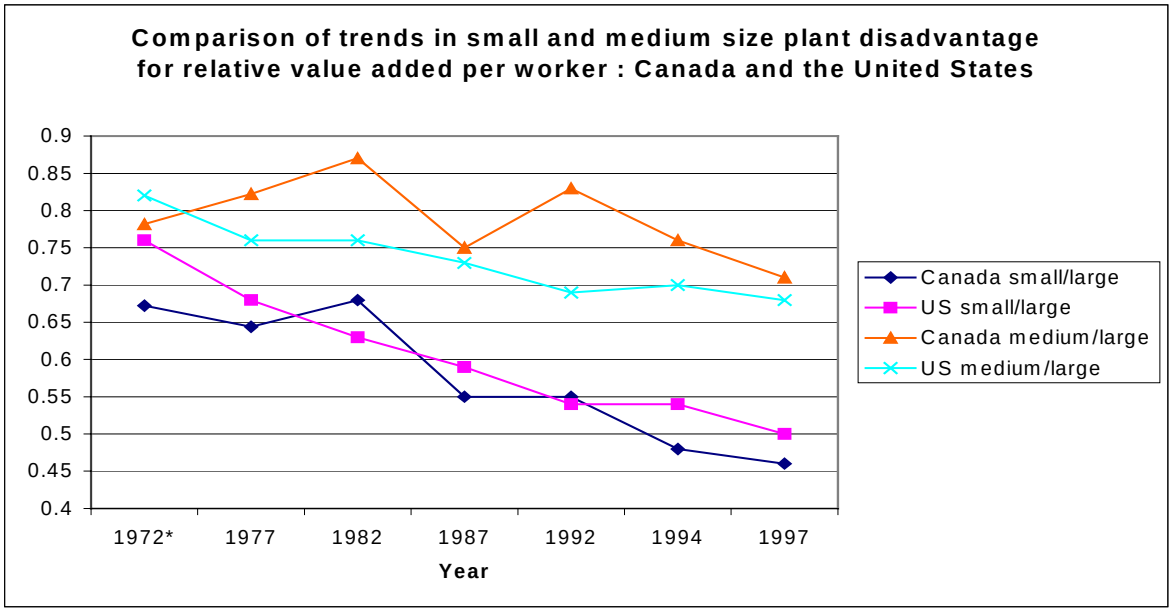
Comparison of trends in small and medium size plant disadvantage for relative value added per worker : Canada and the United States
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
1972*
1977
1982
1987
1992
1994
1997
Year
Canada small/large
US small/large
Canada medium/large
US medium/large

Figure 2

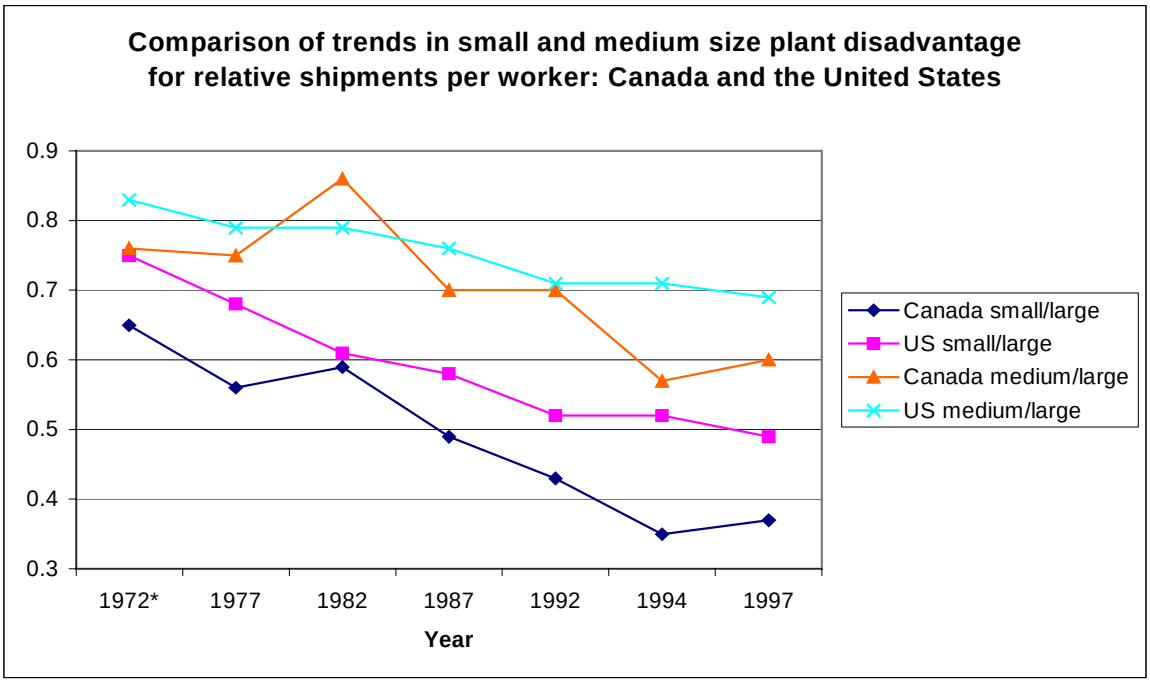
Comparison of trends in small and medium size plant disadvantage for relative shipments per worker: Canada and the United States
0.9
0.8
0.7
0.6
0.5
0.4
0.3
1972*
1977
1982
1987
1992
1994
1997
Year
Canada small/large
US small/large
Canada medium/large
US medium/large

Figure 3

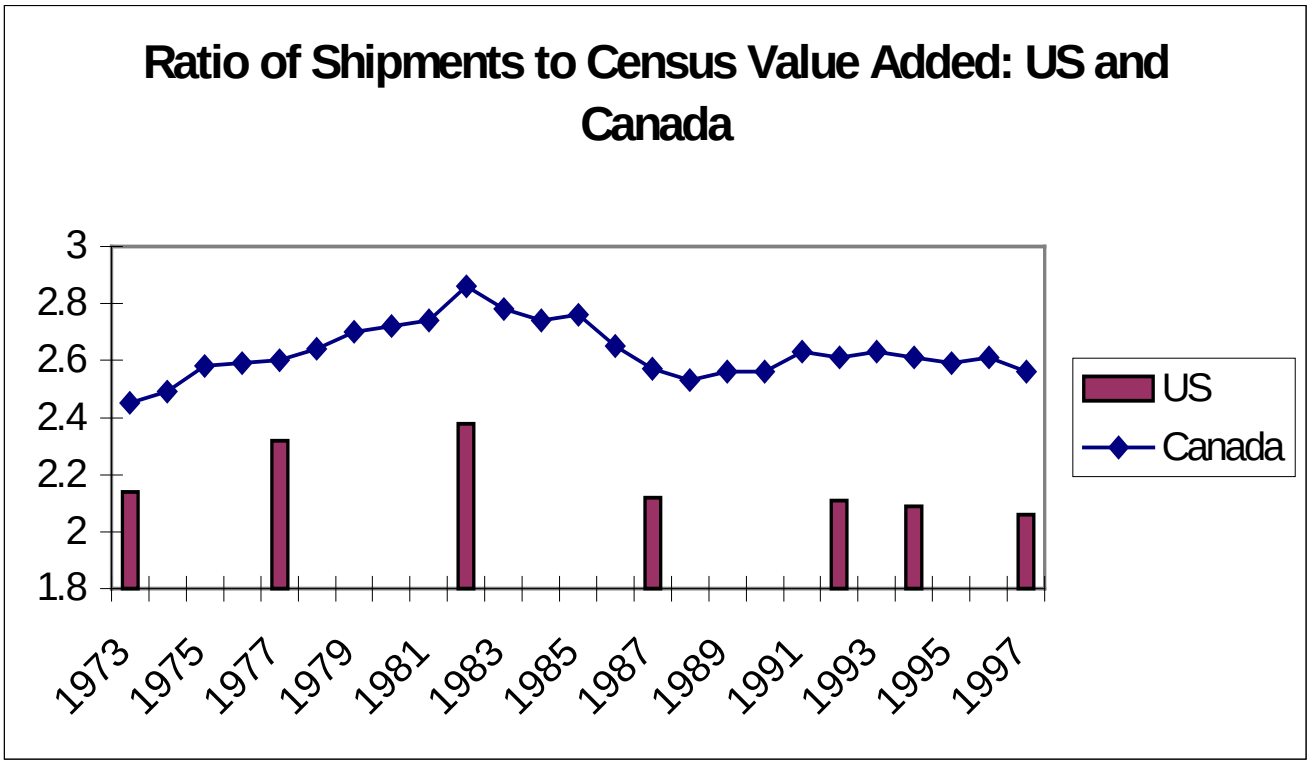
Ratio of Shipments to Census Value Added: US and Canada
3
2.8
2.6
2.4
2.2
2
1.8
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
US
Canada

Figure 4